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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexteriry. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

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Development of USES Aptitude Test Battery

for

Mounter

(electronics) I 726.887

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U.S. DEPARTMENT OF LABOR
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BUREAU OF EMPLOYMENT SECURITY
Washington, D.C. 20210

Technical Report on Development of USES Aptitude Test Battery

For .....

Mounter (electronics) I 726.887

S-8

U. S. Employment Service
in Cooperation with
Indiana, Ohio, Pennsylvania, and Tennessee
State Employment Services

January 1967

FOREWORD

The United States Employment Service General Aptitude Test Battery (GATB) was first published in 1947. Since that time the GATB has been included in a continuing program of research to validate the tests against success in many different occupations. Because of its extensive research base the GATB has come to be recognized as the best validated multiple aptitude test battery in existence for use in vocational guidance.

The GATB consists of 12 tests which measure 9 aptitudes: General Learning Ability, Verbal Aptitude, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, Motor Coordination Finger Dexterity, and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, with a standard deviation of 20.

Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, in combination, predict job performance. For any given occupation, cutting scores are set only for those aptitudes which contribute to the prediction of performance of the job duties of the experimental sample. It is important to recognize that another job might have the same job title but the job content might not be similar. The GATB norms described in this report are appropriate for use only for jobs with content similar to that shown in the job description included in this report.

Frank H. Cassell

Frank H. Cassell, Director
U. S. Employment Service

GATB Study #453, 583
637

DEVELOPMENT OF USES APTITUDE TEST BATTERY

For

Mounter (electronics) I 726.887

S-8

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Mounter I 726.887. The following norms were established:

GATB Aptitudes	Minimum Acceptable GATB, B-1002 Scores
P - Form Perception	85
K - Motor Coordination	85
F - Finger Dexterity	85
M - Manual Dexterity	80

RESEARCH SUMMARY

Sample:

208 female workers employed at the General Electric Company in Ohio and Indiana, and the Galeton Production Company in Pennsylvania.

Criterion:

Ohio Sample - production ratings
Pennsylvania sample - production ratings
Indiana sample - supervisory ratings

Design:

Concurrent (tests and criterion data were collected at approximately the same time).

Minimum aptitude requirements were determined on the basis of a job analysis and statistical analyses of aptitude mean scores, standard deviations, aptitude-criterion correlations and selective efficiencies.

Concurrent Validity:

Phi Coefficient = .21 ($P/2 < .005$)

Effectiveness of Norms:

Only 61% of the non-test-selected workers used for this study were good workers; if the workers had been test-selected with the S-8 norms, 67% would have been good workers. Thirty-nine per cent of the non-test-selected workers used for this study were poor workers; if the workers had been test-selected with the S-8 norms only 33% would have been poor workers. The effectiveness of the norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Workers	61%	67%
Poor Workers	39%	33%

SAMPLE DESCRIPTION

Size: N = 208

Occupational Status: Employed workers

Work Setting: Workers were employed at the General Electric Company at the Euclid Lamp Works, Cleveland, Ohio, the Youngstown Lamp Works, Youngstown, Ohio, and the Ohio Lamp Works, Warren, Ohio, at the Galeton Production Company, Galeton, Pennsylvania, and at the General Electric Company, Tell City, Indiana.

Employer Selection Requirements:

Education: Ohio Sample - 8th grade
Pennsylvania Sample - none
Indiana Sample - high school, however this requirement is flexible.

Previous Experience: none

Tests: none

Other: Ohio Sample - personal interview
Pennsylvania Sample - personal interview and at least 25 years old.
Indiana Sample - age range of 18-30 years.

Principal Activities: The job duties for each worker are comparable to those shown in the job description in the Appendix.

Minimum Experience: All workers in the sample had at least six months total job experience.

TABLE 2

Means, Standard Deviations (SD), Ranges and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education and Experience

Age (years)	N	Mean	SD	Range	r
Sample I - Ohio	100	24.9	3.7	19-36	.304**
Sample II - Pennsylvania	65	24.0	5.1	18-43	.255*
Sample III - Indiana	43	23.7	4.5	18-36	#-.118
Education (years)					
Sample I - Ohio	100	11.3	1.0	9-12	.064
Sample II - Pennsylvania	65	11.3	1.4	7-13	-.020
Sample III - Indiana	43	10.7	1.5	8-12	#.233
Experience (months)					
Sample I - Ohio	100	43.9	27.7	6-132	.362**
Sample II - Pennsylvania	65	21.4	21.2	6-86	.175
Sample III - Indiana	43	27.8	18.7	6-86	#-.307*

\# Corrected for broad categories
* Significant at the .05 level
** Significant at the .01 level

EXPERIMENTAL TEST BATTERY

All the tests of the GATB, B-1001, were administered to each sample during 1950 and 1951.

CRITERION

The criterion data from the Ohio and Pennsylvania sample consisted of production ratings and the criterion data from Indiana consisted of supervisory ratings of job proficiency made at approximately the same time as test data were collected.

Rating Scale: The anticipated earning rate was calculated for the Ohio and Pennsylvania sample. Supervisory ratings in broad categories were used for the Indiana sample.

Criterion Dichotomy: Each of the three studies was dichotomized separately into low and high groups. When they were combined, 39% of the total sample was placed in the low group to correspond with the percentage of workers considered unsatisfactory or marginal. Workers in the high criterion group were considered "good workers" and those in the low group as "poor workers."

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were selected for tryout in the norms on the basis of a qualitative analysis of test and criterion data. Aptitude P which does not have a significant correlation with the criterion was considered for inclusion in the norms because the job analysts indicated that this aptitude was important for the job duties and the sample had a relatively high mean. With employed workers, a relatively high mean score may indicate some sample preselection. Tables 3, 4, and 5 show the results of the qualitative and statistical analyses.

TABLE 3

Qualitative Analysis
(Based on the job analysis the aptitudes listed appear to be important to the work performed)

Aptitude	Rationale
P - Form Perception	Required to assemble radio tube mounts and stems; to visually inspect glass stems for defects and to adjust wire component of stem; to visually examine completed mount for conformity of shape.
K - Motor Coordination	Required in positioning small and medium sized parts and wires either manually or with tweezers.
F - Finger Dexterity	Required to use tweezers and small hand tools in positioning, connecting, and fastening operations.
M - Manual Dexterity	Required to use small hand tools in positioning, connecting and fastening operations.

TABLE 4a

Means, Standard Deviations (SD), and Ranges for the Aptitudes of the GATB; B-1001, N = 208

Aptitudes	Mean	SD	Range
G - General Learning Ability	101.5	14.6	68-142
V - Verbal Aptitude	97.2	12.7	68-126
N - Numerical Aptitude	102.7	16.1	58-144
S - Spatial Aptitude	103.8	16.1	60-137
P - Form Perception	110.4	16.3	70-155
Q - Clerical Perception	104.6	14.5	65-148
A - Aiming) K	108.5	15.8	33-163
T - Motor Speed)	102.4	16.8	56-154
F - Finger Dexterity	113.5	17.1	66-166
M - Manual Dexterity	110.0	19.8	41-156

TABLE 4b

Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB, B-1001 for the three studies; Total N = 208

Aptitudes	N=100	N=65	N=43
G - General Learning Ability	.029	-.075	.256
V - Verbal Aptitude	-.021	-.061	.309*
N - Numerical Aptitude	.097	.064	.194
S - Spatial Aptitude	-.025	-.009	.161
P - Form Perception	-.017	.015	.273
Q - Clerical Perception	.100	.097	.235
A - Aiming)	.211*	.229	.178
T - Motor Speed) K	.337**	.191	.140
F - Finger Dexterity	.177	.437**	.317*
M - Manual Dexterity	.541**	.353**	.209

* Significant at the .05 level
** Significant at the .01 level

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data									
Important					X		X	X	X
Irrelevant									
Relatively High Mean					X			X	X
Relatively Low Standard Dev.	X	X				X			
Significant Correlation with Criterion		X					X	X	X
Aptitudes to be Considered for Trial Norms		V			P		K	F	M

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of a comparison of the degree to which trial norms consisting of various combinations of aptitudes V, P, K, F, and M at trial cutting scores were able to differentiate between the 61% of the sample considered good workers and 39% of the sample considered poor workers. Trial cutting scores at five-point intervals approximately one standard devi-

ation below the mean are tried because this will eliminate about one-third of the sample with three-aptitude norms. For two aptitude trial norms, minimum cutting scores slightly higher than one standard deviation below the mean will eliminate about one-third of the sample. The Phi Coefficient was used as a basis for comparing trial norms. Norms of P-85, K-85, F-85, and M-80 provided the highest degree of differentiation for the occupation of Mounter I, 726.887. The validity of these norms is shown in Table 6 and is indicated by a Phi Coefficient of .21 (statistically significant at the .005 level).

TABLE 6

Concurrent Validity of Test Norms
P-85, K-85, F-85, and M-80

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	20	107	127
Poor Workers	27	54	81
Total	47	161	208

Phi Coefficient = .21 Chi Square (X^2) = 8.7
Significance Level = P/2 $<$ .005

DETERMINATION OF OCCUPATIONAL APTITUDE PATTERN

The data for this study met the requirements for incorporating the occupation studied into OAP 35 which is shown in Section II of the Manual for the General Aptitude Test Battery. A Phi Coefficient of .19 is obtained with the OAP-35 norms of K-85, F-80 and M-80.

GATB Study #521 S-8

Mounter (electronics) I 726.887

Check Study #1 Research Summary

Sample:
73 female workers employed at the Memphis Lamp Works of the General Electric Company, Memphis, Tennessee in December 1949.

TABLE 7

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with Criterion (r) for Age, Education, Experience and Aptitudes of the GATB, B-1001-Cross Validation Sample #1

	Mean	SD	Range	r
Age (years)	23.7	4.6	18- 37	-.231*
Education (years)	10.7	1.6	8- 16	-.075
Experience (months)	9.6	2.2	6- 13	.371**
G - General Learning Ability	95.6	14.4	71-142	.034
V - Verbal Aptitude	91.8	14.1	68-144	-.023
N - Numerical Aptitude	92.2	17.5	54-131	.115
S - Spatial Aptitude	98.8	16.0	65-128	-.002
P - Form Perception	94.9	16.8	52-143	.019
Q - Clerical Perception	88.4	15.9	52-124	.099
A - Aiming } K	93.7	16.8	49-137	.242*
T - Motor Speed } K	90.6	18.3	43-163	.038
F - Finger Dexterity	106.0	17.1	69-138	.259*
M - Manual Dexterity	103.5	18.4	58-157	.287*

*Significant at the .05 level
**Significant at the .01 level

Criterion:
Production records

Design:
Longitudinal (test data was collected prior to employment and criterion data was collected after completion of training).

Principal Activities:
The job duties for each worker are those shown in the job description in the Appendix.

Predictive Validity:
Phi Coefficient = .26 ($P/2 < .025$)

Effectiveness of Norms:
Only 81% of the non-test selected workers in this sample were good workers; if they had been test-selected with the S-8 norms, 91%

would have been good workers. The effectiveness of the norms when applied to this independent sample is shown graphically in Table 8.

TABLE 8

Effectiveness of S-8 Norms on Check Study #1

	Without Tests	With Tests
Good Workers	81%	91%
Poor Workers	19%	9%

Predictive Validity of Test Norms
(P-85, K-85, F-85, M-80)
Check Study Sample #1 (Tennessee)

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Workers	27	32	59
Poor Workers	11	3	14
Total	38	35	73

Phi Coefficient (ϕ) = .26 Chi Square (X^2) = 4.9
Significance Level = $P/2 < .025$

January 1967 A-P-P-E-N-D-I-X S-8

FACT SHEET

Job Title: Mounter (electronics) I 726.887

Job Summary (Pennsylvania): Assembles radio tube mounts and stems, consisting primarily of cathode, grids, and plate by positioning and connecting very small and medium sized parts and wires manually and using tweezers, and spot welding parts in place.

Work Performed (Pennsylvania): Picks up a cathode (hollow oblong metal piece, about ½ inch in length) using tweezers and positions upright in mica disc; picks up grid (two coarse wires, wound with a number of turns) and fits it over cathode; positions with pressure of fingers. Using same method, fits larger grid over first grid and cathode; picks up plate (small, curved strip of metal attached to two upright prongs) and inserts lower ends of prongs into bottom mica; places top mica (similar to bottom mica) over assembly. Inserts four legs of confining plate through perforations in top mica which extend into perforations in bottom mica and using tweezers, clinches ends of prongs to hold mount together.

Finishes mount assembly of radio tubes by spot welding parts of mount to parts of stem. Spot welds bottom shield (circular metal plate with perforations and small projection) against bottom mica; welds bottom plate to confining plate legs at four points; picks up a carbon shield, using tweezers, and welds to bottom shield. Spot welds a wire in stem to one projecting prong of plate; welds wire connectors to a grid side rod which extends through bottom of mount; welds getter (square loop of wire and metal pieces) in a horizontal position on top of assembled unit. Pulls very fine wire from cathode and welds against a stem pin. Positions cathode manually and welds two wires (heater legs) inside small hooks projecting from stem pins; welds other ends of heater legs to lower end of cathode; places completed stem and mount assembly in tray.

Job Summary (Ohio): Fastens coils of tungsten filament wire to stem to form mounts for incandescent lamps, manually and using tweezers and mounting pliers.

Work Performed (Ohio): Takes stem with left hand from conveyor which passes in front of work stations or from tray at left and visually examines it for defects such as cracks in glass, loops and spacing of supports, and completeness of assembly; picks up filament coil from coil pan, using tweezers in right hand, inserts end of coil through open loop of stem wire, places stem wire and coil between pinchers of mounting pliers; steps on pedal which brings pinchers together and clamps ends of coil and lead wire securely. Grasps unattached end of coil with tweezers and strings coil through open loops of supports to other lead wire while simultaneously revolving stem in left hand so that each support in turn contacts the coil; inserts end of coil in loop end of other lead wire and clamps together in mounting pliers. Makes minor adjustments, using tweezers or fingers, in shaping and positioning coil, supports and lead wires. Occasionally uses small hand pliers to adjust other wire components of stem. Visually examines completed mount for even spacing of supports, coil stretch, coil pinching, over-lapping of coil ends and conformity of shape. May use an alignment jig to determine if mount is straight.

Job Summary (Tennessee): Fastens coil of tungsten filament wire to stem, manually and using tweezers and mounting pliers, to form mounts for Christmas tree lamps.

Work Performed (Tennessee): Removes a stem from slowly moving conveyor belt; picks up a filament (coil) approximately one inch long from a rubber tray, using tweezers. Inserts filament, using tweezers, into one of lead wire hooks held in mounting pliers, and depresses foot pedal causing mounting pliers to clamp filament in hook securely. Employs rapid and dexterous finger, hand and arm movements and using tweezers, to thread (wind) filament around three fine wire supports and through other lead wire hook, clamping wire down firmly by means of mounting pliers. Places assembly into tray.

Stops conveyor and signals Maintenance Mechanic if mounts show signs of defective workmanship.

Job Summary (Indiana): Assembles small parts of radio tubes manually using tweezers and spot welding equipment.

Job Description (Indiana): Assembles heaters, cathodes, grids, beam shields, and plates by placing them into punched mica separators, manually and using tweezers. Spot welds terminals of assembly to connections in stems of tube base, using foot operated electrical spot welder. Uses other hand tools such as wire cutters, scissors, and jigs to position parts of tubes.

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January 1967 A-P-P-E-N-D-I-X S-8

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